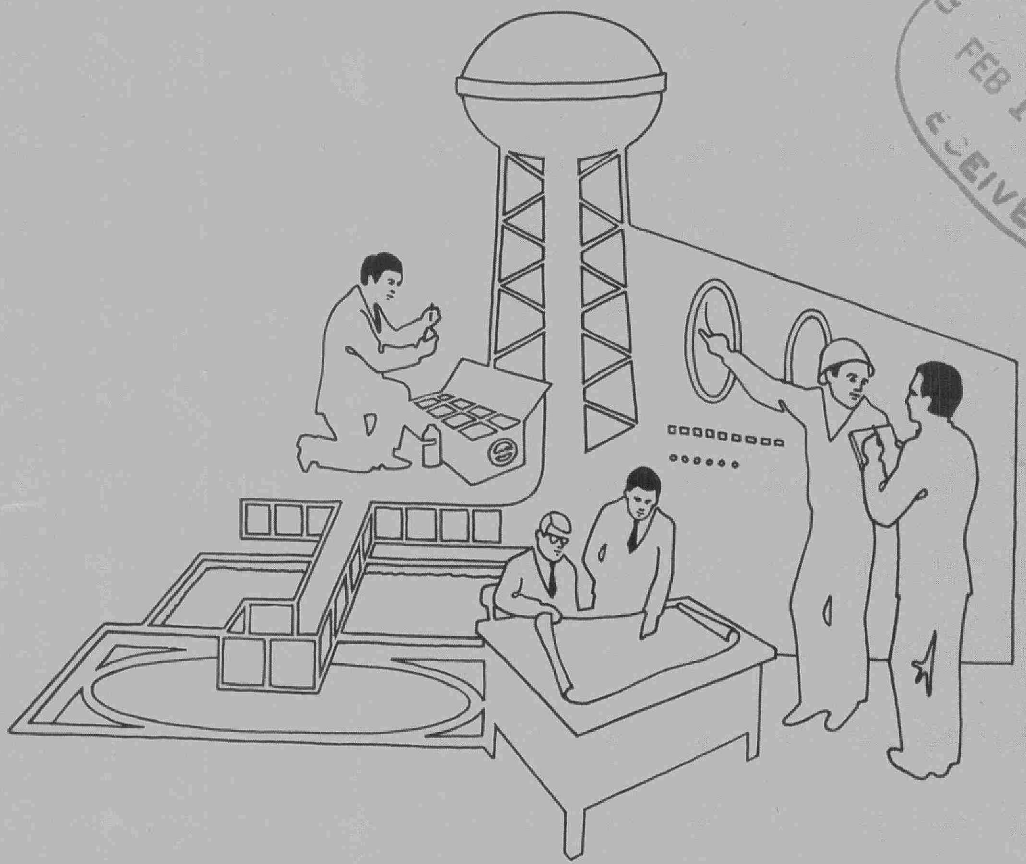
Water management in Ontario

Ontario Water Resources Commission

District Engineers Branch



POLLUTION SURVEY OF ATIKOKAN RIVER

SEPTEMBER 29, 1969 AND SEPTEMBER 15, 1970

DIVISION OF SANITARY ENGINEERING - THUNDER BAY REG. OFFICE

REPORT

Ontario Water Resources Commission

Municipality Township of Atikokan Date of Inspection September 29, 1969 / September 15, 1970

Re: POLLUTION SURVEY OF ATIKOKAN RIVER

Field Inspection by H. Weickert, P.Eng. Report by H. Weickert, P.Eng.

INTRODUCTION

On September 29, 1969, and September 15, 1970, water quality surveys were carried out by Messrs. H. Weickert and W. Grobelny respectively, on the Atikokan River as it passes through the Town. In the initial survey, assistance was provided by Mr. H. Shannon, Sewer and Water Foreman, Township of Atikokan. A preliminary biological survey was also conducted over the same reach of the river on October 15, 1970, by Mr. M. German, OWRC Regional Biologist.

SUMMARY

Two water quality surveys were conducted on the Atikokan River as it passes through Atikokan. The first was carried out at a time of high flow in the river while the most recent one was at low flow. A preliminary biological survey was also conducted and it provided supporting bacteriological and chemical water quality data, as well as biological data on the bottom fauna.

These surveys indicated large increases in the bacteriological population, presumably due to discharges of sewage effluents without the benefit of disinfection. Some signs of nutrient and organic enrichment were also detected in addition to increases in dissolved and suspended matter, as the river flowed through Atikokan. An increase in the iron concentration in the river water was also noted in the 1970 survey and this

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was attributed to storm water runoff from the streets because of the rain at the time of the survey.

A recommendation is made which suggests further biological studies on the Atikokan River, as well as Steep Rock Lake, in order to ascertain the degree of organic and nutrient enrichment which has taken place. A second recommendation is made to the Township of Atikokan to undertake a program to provide a sewage disposal system which will provide adequate and acceptable treatment to the Town's sewage wastes.

USES OF THE RIVER

The Township of Atikokan draws approximately 1 million gallons of water daily for its domestic supply from the Atikokan River above Little Falls. Most of this water finds its way back to the river again in the form of domestic sewage. Two parks abut the river but there are no formal recreational activities which utilize the river itself. During the surveys, evidence of children's activities were noted at various points along the river banks and reportedly children fish for suckers near the Saturn Avenue bridge in the spring of the year. Motor boats and canoes utilize the river as route from Town to Steep Rock Lake.

Domestic sewage from the various areas in the town drain to eight major sedimentation tanks situated along the Atikokan River. In addition, sewage from O'Neil's Trailer Park and the West End Trailer Park is directed to private sedimentation tanks serving these developments. Effluents from all these facilities are discharged to the Atikokan River without the benefit of further treatment. An additional municipal-owned sedimentation tank serves the Ontario Provincial Police Detachment and a picnic area. The effluent flow from this facility is reportedly minimal and it is discharged to a small creek

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which connects to the Atikokan River. Some private discharge pipes were also noted along the river bank outside the serviced area. These appeared to serve individual residences.

A separate storm sewer system has been provided in the townsite with the storm water runoff being discharged to the Atikokan River at various locations.

PREVIOUS SURVEYS

A series of chemical and bacteriological samples were collected upstream and downstream from the various sedimentation tank outfalls along the Atikokan River by OWRC staff on April 13 and 14, 1967. This sampling demonstrated a progressive increase in the conductivity of the river water as it passed through the town, which indicated that the dissolved solids content of the river was increased, probably due to the discharge of domestic wastes. Increases in turbidity and suspended solids were also noted, indicating addition of particulate matter to the river water. The most dramatic water quality changes, however, were not chemical, but rather, they were bacteriological. Both the total coliform and E. Coli.concentrations increased considerably as the water flowed through Atikokan.

STUDY AREA AND SAMPLING LOCATIONS

From the diagram presented in Appendix A, it can be seen that the reach of the river which was the subject of the water quality surveys, extended from upstream of the town near Little Falls to a point downstream from the settling tank outfall for the West End Trailer Park. Chemical and bacteriological samples were generally collected both upstream and downstream from various sedimentation outfalls.

Sampling during the 1969 survey was conducted by use of the Atikokan Fire Department boat and the samples were collected in mid-stream at a depth

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of approximately six or eight inches below the water surface. Due to low river levels, the 1970 survey was carried out by sampling from the shoreline. In this case, samples were collected by the use of a sampler with a twelve foot long handle. Thus, the samples were actually taken approximately eight feet from shore and generally on the side of the river where the sedimentation tank was located.

CLIMATIC CONDITIONS DURING SURVEYS

At the time of the September, 1969, survey, the river level was quite high, due to intense rains on the days prior to the sampling. The river level had risen to such a height that river water was backing up the outfall pipe and entering the Mercury Avenue sedimentation tank. Also, it was possible to pass over the rapids at the site of the old water pumphouse, in an outboard motor boat utilized in the survey.

As mentioned earlier, the 1970 survey was conducted at a period of low flow in the river. However, rain was falling at the time of sampling and the air temperature was quite cool.

ANALYTICAL RESULTS FOR SAMPLES COLLECTED

The analytical results for the bacteriological and chemical samples collected during the two surveys are presented in tabular form in Appendix B. An explanation of some of the parameters is presented in Appendix C.

The analyses did not show any significant increases in BOD or decreases in dissolved oxygen. However, results of both surveys did indicate increases in soluble phosphorus and suspended solids concentrations. The chemical analyses also pointed out increases in the free ammonia concentrations in a downstream direction and also from the 1969 to 1970 sampling. This latter effect was probably due to the lower flow in the river and subsequent reduction in dilution water available for the sewage effluents being discharged to the river. Similar increases were also noted for the Kjeldahl nitrogen concentration of the river water.

Iron determinations were also made for samples collected during the 1970 survey and an increase in this parameter was noted as the water flowed through Atikokan. This effect can likely be attributed to storm water runoff from the streets rather than domestic sewage discharge. As noted earlier, rain was falling during the survey. Significant increase in the coliform bacteria count were also noted in both surveys. The 1970 results demonstrate an increase in the coliform count as the water passed the Saturn Avenue tank and a further large increase downstream from the Mercury Avenue tank. Beyond that, the counts generally remained elevated but within the same order of magnitude. Also, the 1970 counts were higher than those for 1969, probably due to the lower amount of dilution water available in the river.

PRELIMINARY BIOLOGICAL SURVEY

A preliminary biological survey was conducted on the Atikokan River on October 15, 1970, by the Regional Biologist, Thunder Bay Regional Office. The section of the river investigated extended from above Little Falls to below the West End Trailer Park with samples being collected for chemical, biological and bacteriological examination.

The findings of the chemical and bacteriological analyses were generally similar to those discussed earlier. The biological examination of the bottom fauna, indicated that changes in the biological communities had taken place from the upstream to the downstream station. There was an increase in the number of pollution tolerant organisms and a decrease in the total number of taxa present. However, high numbers of relatively intolerant mayfly larvae were present in the downstream sampling points.

A preliminary indication of this survey was that organic enrichment of the river was taking place but the ecological effects appeared to be minimal. It was stated that definite conclusions in this regard should await further and more intense investigation.

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DISCUSSION

The results of the various surveys indicated that severe chemical pollution of the river was not evident in the study area although there were definite indications that the quality of the river was being adversely affected in this regard.

As mentioned, the preliminary biological survey confirmed the fact that organic enrichment of the river water and bottom sediments was taking place. The most obvious and the most severe pollution noted pertained to the large increase in the bacteriological population of the river water. There can be no doubt that this factor is due to the discharge of non-disinfected sewage effluents to the river.

Increases in dissolved and suspended matter and nutrients were noted in the river and this can be attributed to the lack of adequate sewage treatment facilities. Sedimentation tanks are a primitive form of treatment which initially remove some of the solids in the raw sewage but the maximum treatment efficiency which can be obtained from this type of facility is not sufficient to protect the quality of the receiving water. Higher forms of waste treatment which include biological degradation of organic matter and possibly even removed of nutrients are required in order to accomplish this objective.

RECOMMENDATIONS

(1) The Township of Atikokan should undertake a program to provide a sewage disposal system which will give adequate and acceptable treatment to the Town's sewage wastes.

(2) The OWRC Biology Branch should undertake further studies on the Atikokan River and Steep Rock Lake to ascertain the degree of organic and nutrient enrichment of the waters. This information should be utilized

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in determining the type of sewage treatment required in the Town.

Prepared by: _____

H. Weickert, P.Eng.
Division of Sanitary Engineering

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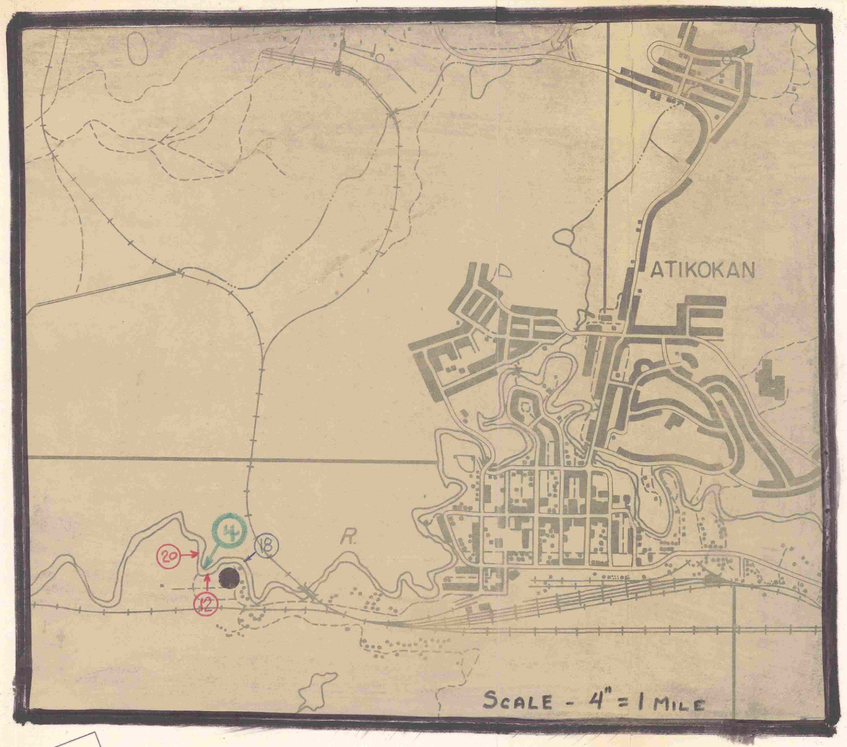
ATIKOKAN



LEGEND

- Sedimentation Tank
- 1969 Sampling Point
- 1970 Sampling Point
- Biological Sampling Point

ONTARIO WATER RESOURCES COMMISSION

TOWNSHIP OF ATIKOKAN

ATIKOKAN RIVER SURVEYS

SCALE 600 0 600 1200 FT.	
DRAWN BY D.H.	DATE OCT. 1967
CHECKED BY:	DRAWING NO 67-82

Atikokan River Survey

Downstream →

Station #		1	2	3	4		5		6		7		8		9		10	
Analysis \ Year 19—		70	70	70	69	70	69	70	69	70	69	70	69	70	69	70	69	70
Solids	Total	32	68	78	60	54	70	70	110	70	78	72	98	54	74	96	100	98
	Suspended	0	4	5	3	5	2	6	4	7	5	10	7	10	5	10	4	15
	Dissolved	32	64	73	57	49	68	64	106	63	73	62	91	44	69	86	96	83
Nitrogen as N	Free NH_3	.03	.01	0.0	.01	0.0	.01	.02	.03	.16	.05	.08	.06	.12	.03	.11	.03	.25
	Total Kjel.	.36	.40	.37	.42	.37	.48	.38	.70	.72	60	56	.50	.68	.75	.68	.55	.[illegible]
	Nitrite	.004	.004	.004	.007	.003	.007	.003	.007	.004	.007	.004	.008	.005	.008	.005	.0[illegible]	.00[illegible]
	Nitrate	<.01	<.01	<.01	.01	<.01	.01	<.01	.01	<.01	.01	<.01	.01	<.01	.01	<.01	.02	<.01
Phos as P	Total	.016	.024	.072	.02	.021	.02	.032	.09	.082	.07	1.1	.05	.12	.08	.095	.09	.15
	Soluble	.005	.005	.054	.01	.006	.02	.015	.05	.047	.03	.56	.04	.086	.04	.060	.[illegible]5	.13
Iron as Fe		.10	.30	.40	-	.40	-	.45	-	.65	-	.75	-	1.2	-	1.1	-	1.2
Streptococcus		14	16	12	-	12	-	144	-	1100	-	500	-	2500	-	800	-	1200
Background Ionics		-	-	-	+++	-	+++	- -	+++	-	+++	-	+++	-	+++	-	+++	- -
Coliform Organisms		3300	3300	2900	172	1000	2400	32,000	106,000	680,000	50,000	370,000	48,000	690,000	71,000	530,000	130,000	760,000
BOD₅		1.1	1.3	1.4	1.6	1.1	1.3	1.3	1.8	1.9	23	1.3	1.5	1.8	1.9	1.7	18	22
Dissolved Oxygen		-	9.0	8.0	-	8.0	-	8.0	-	8.0	-	8.0	-	8.0	-	-	-	[illegible]0
% Saturation		-	70	62	-	62	-	62	-	62	-	62	-	62	-	-	-	70

Stations

1- Below Municipal Water Intake
2- Above Saturn St Tank - From Bridge
3- Below Saturn St. Tank
4- Above Mercury Ave Tank
5- Below Mercury Ave. Tank
6- Below Maple Cres Tank
7- Above O'Brien St. Tank
8- Below O'Brien St Tank
9- Above Neptune St Tank
10- Below Neptune St. Tank

APPENDIX "C"

SIGNIFICANCE OF LABORATORY ANALYSES

Bacteriological Examination

The presence of coliforms indicates pollution from human or animal excrement, or from some non-faecal forms. The criteria for total body contact recreation in Ontario is a maximum geometric mean density of 1000 organisms per 100 millilitres, based on a series of at least ten samples per month.

The OWRC Laboratories employ the Membrane Filter (MF) technique of examination to obtain a direct enumeration of coliform organisms. The Department of Health Laboratories use the Most Probable Member (MPN) enumeration and coliform counts are reported as Total Coliform Organisms (TC) and Faecal Coliform Organisms (FC).

Sanitary Chemical Analyses

Biochemical Oxygen Demand (BOD)

Biochemical Oxygen Demand is reported in parts per million (PPM) and is an indication of the amount of oxygen required for the stabilization of decomposable organic or chemical matter in water. The completion of the laboratory test required five days, under the controlled incubation temperature of 20° Centigrade.

Solids

The value for solids, expressed in parts per million, is the sum of the values for the suspended and the dissolved matter in the water. The concentration of suspended solids is generally

the most significant of the solids analyses with regard to surface water quality. The effects of suspended solids in water are reflected in difficulties associated with water purification, decomposition in streams and injury to the habitat of fish.

Nitrogen

Ammonia Nitrogen or sometimes called free ammonia is the insoluble product in the decomposition of nitrogenous organic matter. It is also formed when nitrates and nitrites are reduced to ammonia either biologically or chemically. Some small amounts of ammonia, too, may be swept out of the atmosphere by rain water.

The following values may be of general significance in appraising free ammonia content: Low 0.015 to 0.03 ppm; moderate 0.03 to 0.10 ppm; high 0.10 or greater.

Total Kjeldahl is a measure of the total nitrogeneous matter present except that measured as nitrite and nitrate nitrogens. The Total Kjeldahl less the Ammonia Nitrogen measures the organic nitrogen present. Ammonia and organic nitrogen determinations are important in determining the availability of nitrogen for biological utilization. The normal range for Total Kjeldahl would be 0.1 to 0.5 ppm.

Nitrite Nitrogen

Nitrite is usually an intermediate oxidation of ammonia. The significance of nitrites, therefore, varies with their amount, sources, and relation to other constituents of the

sample, notably the relative magnitude of ammonia and nitrite present. Since nitrite is rapidly and easily converted to nitrate, its presence in concentrations greater than a few thousandths of a part per million is generally indicative of active biological processes in the water.

Nitrate Nitrogen

Nitrate is the end product of aerobic decomposition of nitrogenous matter, and its presence carries this significance. Nitrate concentration is of particular interest in relation to the other forms of nitrogen that may be present in the sample. Nitrates occur in the crust of the earth in many places and are a source of its fertility.

The following ranges in concentration may be used as a guide: low less than 0.1 ppm; moderate 0.1 to 1.0 ppm; high greather than 1.0 ppm.

Anionic Detergents as ABS

The presence of anionic detergents as ABS is an indication that domestic waste is present.

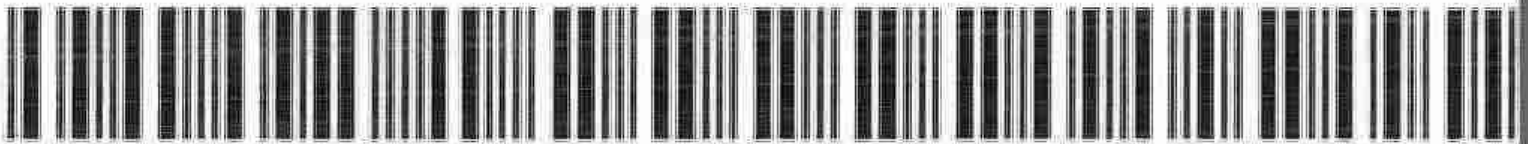
Phenols

The presence of phenol or phenolic equivalents is generally associated with discharges containing petroleum products, or with wastes from some industries. It is generally conceded that adequate protection of surface waters will be provided if the concentration of phenols in waste discharges does not exceed

20 parts per billion (ppb). Phenolic type waste can cause objectionable conditions in water supplies and might taint the flesh of fish.

Iron

Water for domestic use should contain less than 0.3 parts per million of iron in order to avoid objectionable tastes, staining and sediment formation. Iron concentrations of not greater than 17 parts per million in waste discharges should permit adequate protection of surface waters.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